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NATIONAL DAM SAFETY PROGRAM, HERZENBERG DAM (NJ00145), WALLKILL--ETC(U)
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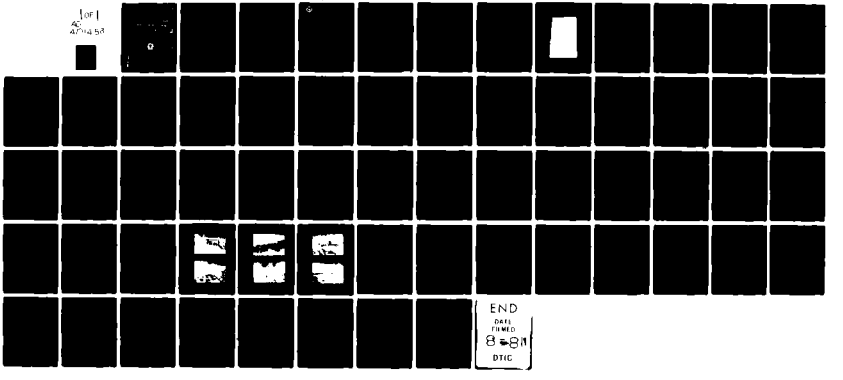

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WALLKILL RIVER BASIN
TRIBUTARY TO PAPAKATING CREEK
SUSSEX COUNTY
NEW JERSEY

HERZENBERG DAM
NJ 00146

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

REPT. NO: DAEN/NAP-53842/NJ00146-81/07

JULY 1981

National Dam Safety Program. Herzenberg Dam (NJ00145), Wallkill River Basin, Tributary to Papakating Creek, Sussex County, New Jersey. Phase I Inspection Report.

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Embankments	Herzenberg Dam, New Jersey
Visual Inspection	Seepage
Structural Analysis	Erosion

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

30 JUN 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Herzenberg Dam, Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Hezenberg Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in good overall condition. However, the spillway is considered inadequate, as 14 percent of the 100 year design flood would cause the dam to be overtopped. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. However, to assure the continued functioning of the dam and its impoundment, the following remedial actions could be undertaken by the owner:

a. Fill, regrade, and reseed the eroded embankment areas and add riprap at the new higher waterline on the upstream slope.

b. Remove the thickets, brush and saplings from both slopes.

c. Resurface the areas of spalled concrete at the primary spillway.

d. Provide weepholes at the bottom of both wingwalls on the right side of the spillway to relieve the hydrostatic pressure and monitor these wingwalls for further movement.

e. Monitor the seepage near the left abutment for movement of fine material and to ascertain that the seepage is not flowing through the dam.

f. Develop a periodic inspection and maintenance program whereby any further deterioration could be noted and corrective measures undertaken.

g. Operate the low level drain several times a year to ensure its proper functioning.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

for Kenneth R Moser maj CE DDE
JAMES G. TON
Colonel, Corps of Engineers
Commander and District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

HERZENBERG DAM (NJ00146)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 26 March 1981 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Hezenberg Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in good overall condition. However, the spillway is considered inadequate, as 14 percent of the 100 year design flood would cause the dam to be overtopped. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. However, to assure the continued functioning of the dam and its impoundment, the following remedial actions could be undertaken by the owner:

a. Fill, regrade, and reseed the eroded embankment areas and add riprap at the new higher waterline on the upstream slope.

b. Remove the thickets, brush and saplings from both slopes.

c. Resurface the areas of spalled concrete at the primary spillway.

d. Provide weepholes at the bottom of both wingwalls on the right side of the spillway to relieve the hydrostatic pressure and monitor these wingwalls for further movement.

e. Monitor the seepage near the left abutment for movement of fine material and to ascertain that the seepage is not flowing through the dam.

f. Develop a periodic inspection and maintenance program whereby any further deterioration could be noted and corrective measures undertaken.

g. Operate the low level drain several times a year to ensure its proper functioning.

APPROVED: Kenneth R. Mader, Maj CE Dep
for JAMES G. TON
Colonel, Corps of Engineers
Commander and District Engineer

DATE: 30 June 1981

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Herzenberg Dam Fed ID# NJ 00146
N.J. ID# 22-166

State Located New Jersey
County Located Sussex
Coordinates Lat. 4113.5 - Long. 7438.8
Stream Tributary to West Branch-Papakating Creek
Date of Inspection March 26, 1981

ASSESSMENT OF
GENERAL CONDITIONS

Herzenberg Dam is in a good overall condition, although its spillways, as presently modified, can accommodate only 13.6% of the 100-year design flood. It is recommended that its hazard classification be downgraded to low since overtopping or failure of the dam would cause no loss of life and little, if any, downstream damage. For the same reasons no further studies are recommended although the owner could restore some of the original spillway capacity by either removing the flashboard, raising the spillway bridge, or removing the road embankment placed across the auxiliary spillway. To ensure the continued functioning of the dam and its impoundment the owner should repair and seed the eroded embankment areas, remove excess vegetation, repair the deteriorated concrete surfaces, and install weep holes in the right wingwalls of the spillway.

A Perera

Abraham Perera P.E.
Project Manager

OVERVIEW OF HERZENBERG DAM

MARCH, 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines can be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I investigations is to identify expeditiously those dams that may pose hazards to human life or property. The assessment of the general condition of the dam is based on available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In the review of this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway test flood is based on the estimated "probable maximum flood" for the region (greatest reasonable possible storm runoff) or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: Herzenberg Dam FED #NJ 00146
and NJ ID # 22-166

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report if authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The state, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia, to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Herzenberg Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Herzenberg Dam is a 370-foot-long earth structure with an impermeable compacted clay cutoff extending along the centerline at the base of the dam. The two spillways located at the right end of the dam consist of a 24.5-foot-long concrete ogee weir and, at the right abutment, a 35-foot-wide earthen auxiliary spillway channel. The embankment, which has a maximum height of about 16 feet, is 15 feet wide at the crest with 3H:1V and 2H:1V slopes upstream and downstream, respectively. A gravel protective layer extends across the upstream face of the dam from crest elevation to below the normal pool elevation, and the downstream embankment is underlain by a 3-foot-thick gravel drain. The embankment itself is composed of relatively impermeable clayey fill. An 18-inch-diameter gate-operated CI drain is located about 100 feet from the left abutment.

b. Location

Herzenberg Dam is located on an unnamed tributary about 4,200 feet north of its confluence with the west branch of Papakating Creek. The damsite is 1,000 feet east of Armstrong Road approximately midway between the towns of Libertyville and Woodbourne in Montage Township, Sussex County, New Jersey.

c. Size Classification

The Herzenberg Dam has a maximum height of 16 feet and a maximum storage capacity of 180.4 acre-feet. Accordingly, this dam is in the small size category as defined by the criteria in the Recommended Guidelines for Safety Inspection of Dams (storage less than 1,000 acre-feet and height less than 40 feet).

d. Hazard Classification

This dam is located in a gently rolling agricultural region of the county. The channel immediately below the dam is very straight and wide with valley side slopes ranging from 10 to 15 percent. Several homes and two light-duty roads are located 3,500 feet downstream of the dam. However, none of the homes would be damaged in the event of a dam failure and any damage to the roads would probably be minimal. Accordingly, it is recommended that this dam be downgraded to a low hazard category.

e. Ownership

This dam is owned by Mr. and Mrs. Richard Quelch, Box 663 RD 4, Sussex, New Jersey, 07461.

f. Purpose of Dam

The purpose of the dam is recreation.

g. Design and Construction History

The dam was designed by Waldo Clarke, P.E., for Morris Herzenberg in 1957. Construction began in 1959 by Dollar and Van Blarcom Contractors and was basically completed by June 1960. Several design changes were made prior to and during construction, including relocation of the primary and auxiliary spillways from the left end and center of the dam to the right side of the dam. In addition, the

elevation and width of the auxiliary spillway crest were changed and the spillway relocated adjacent to the right abutment in 1965.

h. Normal Operating Procedures

The dam is maintained personally by the owner or hired outside help when necessary. Maintenance includes groundkeeping and light repair work to the spillway and footbridge. There are no specific operating procedures in effect at this time with respect to regulation of the lake level via the 18-inch blow-off pipe.

1.3 PERTINENT DATA

a. Drainage Area

Herzenberg Dam has a drainage area of 2.4 square miles, which consists of woodland, cropland, and meadowland.

b. Total spillway capacity at maximum pool (top of dam) elevation - 371 cfs

c. Elevations (Assumed Datum)

Top of dam	- 104.0
Principal spillway crest	- 101.0
Auxiliary spillway crest	- 102.0
Streambed at centerline of dam	- 88.0

d. Reservoir

Length of maximum pool (top of dam)	- 1,600 feet
Length of recreation pool (principal spillway crest)	- 1,400 feet

e. Storage (acre-feet)

Top of dam	- 180.4
Recreation pool	- 113.1

f. Reservoir Surface (acres)

Top of dam	- 23.9
Recreation pool	- 21.1

g. Dam

Type - Earth with 24.5-foot-long concrete primary spillway and earthen auxiliary spillway channel at right abutment

Length - 370 feet
Height - 16 feet
Top width - 15 feet
Side slopes - 3H:1V; 2.5H:1V
Zoning - Unzoned
Impervious blanket - None
Cutoff - 5' x 10' compacted clay cutoff
Grout curtain - None
Drains - 3-foot-thick gravel drain under downstream embankment

h. Diversion and Regulating Tunnel

Type - None

i. Spillways

Type - (a) Primary spillway consists of concrete ogee weir

(b) Auxiliary spillway consists of earth channel excavated at right abutment

Weir length - (a) 24.5 feet

Channel width - (b) 35 feet

Gates - None

U/S Channel - (a) Not applicable

(b) Negatively sloped, vegetated inlet

D/S Channel - (a) Natural, cobble strewn, stream channel

(b) Positively sloped, vegetated outlet.

j. Regulating Outlets

18-inch CI drain at exit invert elevation 87.5

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Details of the 1957 original and 1960 revised design plans were available from the microfilm records of the State Bureau of Flood Plain Management. Additional hydrologic and hydraulic data were obtained from the dam application, review report, and correspondence between the state's reviewing engineer and the designer. The design conforms with currently accepted structural engineering standards, although a design storm with a recurrence interval of only 50 years, as determined by the Central Jersey runoff curve, was utilized in establishing the spillway discharge requirements.

2.2 CONSTRUCTION

Copies of the technical specifications were available for review, although no details pertaining to the actual construction were located. However, post-construction inspection reports by the state's reviewing engineer indicate that several design changes were made during the construction process. These changes have been incorporated into as-built drawings, which basically reflect the dam's present configuration, although several modifications not depicted on the revised plans were noted during the inspection. (See Section 6.1, paragraph d.) The dam is situated across a valley underlain by the Ordovician age Martinsburg shale. This gray, platy sedimentary rock is overlain by a mantle of glacial ground moraine that, at this location, is derived almost entirely from the shale. The gray till is composed of silty clay and gravel-size particles and, when compacted, is relatively impermeable. The design drawings indicate that the compacted cutoff trench extends down into the "blue clay" of the shale-derived till.

2.3 OPERATION

There is no information available pertaining to dam operation. However, since the sole purpose of the dam is the impoundment of a lake for recreational purposes, the spillway appears adequate to perform, unattended, the water level regulation function at the dam.

2.4 EVALUATION

a. Availability

Sufficient engineering data were obtained to assess the structural stability of the embankment. The foundation stability was evaluated within the framework of data provided on the plans, the construction specifications, and in geotechnical references pertaining to the damsite.

b. Adequacy

The field inspection and review of the available engineering data indicate that the dam is of conservative design and is structurally sound and well built. It is believed that the data available are adequate to render this assessment without the necessity of gathering additional information.

c. Validity

The available engineering data indicate that the design concepts are contemporary and conservative in nature. The dam appears to have been constructed according to the specifications and configuration depicted on the revised plans, although both spillway components have been modified since the original construction was completed.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of Herzenberg Dam took place on March 26, 1981. At the time of the inspection, water was discharging over the entire length of the primary spillway and a tailwater was noted at the low level drain outlet. The water in the outlet channel is believed to emanate from the stone and gravel drain that, according to design plans, extends along the entire downstream toe of the dam. Recent maintenance and construction in the form of a gravel road was noted at the dam. The road, extending from the right to the left abutment, crosses the auxiliary spillway and continues along the dam crest as a recently placed and graded layer of shaley bank run. Although maintenance in the form of brush removal and concrete repair has apparently been neglected for several years, the overall condition of the dam and its components is generally good.

b. Dam

The embankment is a straight, relatively low structure lying in a wide, steep-sided valley. An 11-foot-wide gravel road has recently been constructed along the dam crest, but there are no indications of vehicular traffic (such as ruts or tracks) on the crest as yet. A good grass cover has been established on both slopes; however, the downstream side is also being overgrown with thickets and young trees. Apparently, the flashboard emplacement raised the water level in the lake above the protective zone of the riprap on the upstream slope since this face at the water line has a somewhat irregular alignment and is almost vertical due to wave erosion. Light erosion, apparently caused by foot traffic, was also noted on the downstream slope in the area of the outlet pipe. The crest has a very slight undulation that seems to have resulted from the recent grading. Seepage was noted about 12 feet beyond the downstream toe at the left abutment, and the area downstream of the center of the dam appeared damp. While both of these conditions could be due to emanations from the dam's toe drain, it is believed that the wet area at the left end of the dam is due to groundwater moving through

the shale bedrock at the left abutment. The bedding planes of the shale dip toward the dam at this location and are the primary elements of transmissibility in this type of bedrock.

c. Appurtenant Structures

The discharge capacity of the principal spillway has been reduced by the installation of a 12-inch-high flashboard on the crest of the ogee weir and the construction of a girder-supported wood plank bridge over the crest. The bridge soffit extends 8 inches down into the spillway, reducing the clear opening from 4 feet by 24.5 feet to 2.33 feet by 24.5 feet. A spalled line 4 to 8 inches wide and up to 1 inch deep has developed along the entire length of the crest where the discharge over the flashboard hits the weir. Another, lighter line of spalling was noted about one-third of way down the spillway apron and sporatic light spalling and efflorescence were observed on both wingwalls. Light seepage was noted emanating from a lightly spalled area about midway down the right downstream wingwall. The right wingwalls are both displaced one-half inch from the sidewall toward the spillway channel, and light erosion and undercutting were observed at the toe of the left downstream wingwall.

The auxiliary spillway has a thick grass cover with very light sporatic brush noted on the downstream slope. However, a gravel road has been constructed from the right abutment across the control section to the primary spillway. The road embankment, which is 2 to 3 feet high, completely and effectively seals the channel and precludes its use as a spillway.

The 18-inch-diameter steel drain outlet pipe, although slightly rusty, appeared in good condition. The wheel and valve housing unit is tilted about 20 degrees from the vertical plane but also seems to be in good operable condition. Although chained, the wheel could be turned a few inches in either direction and operated smoothly and firmly. Running water observed in the outlet pool and channel is believed to be an emanation from the dam's toe drain rather than leakage past the valve.

d. Reservoir Area

The channel between the upstream wingwalls of the primary spillway was filled to within 4 feet of the spillway crest at the time of construction. The water depth at this location is still 4 feet, but it could not be determined if sedimentation is occuring upstream of the entrance channel. There is only one home on its shoreline, and the lake and its environs is in a relatively pristine state. The slopes surrounding the lake range from gentle to moderately steep and are heavily wooded.

e. Downstream Channel

The primary spillway and outlet channels join a few hundred feet downstream of the dam and flow through a relatively wide (more than 500 feet) valley to a confluence with the west branch of Papakating Creek about 4,200 feet downstream. The valley is uninhabited and wooded for 3,500 feet below the dam, and the homes nearest to the stream appear to be well above flood elevations.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Herzenberg Dam functions as a retaining structure for a recreational lake and was designed to be self-regulating (requiring no manual operational procedures). There is a gated low-level drain, but according to the owner, it is utilized only infrequently.

4.2 MAINTENANCE OF DAM

Presently, there is no formal maintenance performed on the dam. The brush and sapling growth on the slopes of the embankment indicate that there has been little maintenance performed in that area for several years. However, the crest of the dam is in good condition and exhibits signs of recent grading and maintenance.

4.3 MAINTENANCE OF OPERATING FACILITIES

While there does not appear to be a formal maintenance program associated with the operational components of the dam, all are in satisfactory condition and signs of recent work (albeit detrimental) were observed at the auxiliary spillway. The owner's practice of "repairs on an as-needed basis" appears adequate in view of the unsophisticated nature of the dam's components and its low hazard classification.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no formal warning system in effect at this dam. However, due to its low hazard classification, isolated location, and the absence of inhabitants in the immediate downstream area, the lack of a warning system is not considered a serious deficiency at this dam.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

As designed, formal regulatory procedures at this dam appear superfluous. However, the lack of embankment and concrete maintenance should be corrected. While the dam's design inherently provides a considerable measure of flood control

and requires no attendant operational personnel, the modifications to both spillways ignore the original design criteria. It is in the best interest of the owner that the spillways be remodified in order to restore a greater percentage of their original capacity and ensure the continued safe performance of the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

Pursuant to the Recommended Guidelines for Safety Inspection of Dams, Herzenberg Dam is of small size and low hazard. Accordingly, the 100-year frequency storm was chosen as the design flood by the inspecting engineers. Inflow to the lake for the selected storm was calculated utilizing the HEC-1 computer program and precipitation data from Technical Paper 40 and Technical Memorandum NWS HYDRO-3. The peak inflow for the design storm was determined to be 2,363 cfs which, when routed through the lake, was reduced slightly to a peak discharge of 2,322 cfs. The spillway capacity of the dam in its existing condition, with the flashboard and bridge in place at the principal spillway, and the auxiliary spillway obstructed by the recent construction of a road, is 317 cfs. Accordingly, it can safely accommodate only 13.6% of the 100-year storm.

b. Experience Data

There are no streamflow records available for this site, nor have records been kept regarding the dam's hydraulic performance since its construction.

c. Visual Observations

There is no evidence of recent problems. The lake level was at normal pool elevation at the time of inspection. The normal pool elevation, however, has been raised 1 foot above design elevation by the insertion of a flashboard at the principal spillway. In addition, a bridge has recently been constructed over the main spillway and its soffit protrudes 0.67 feet below the top of dam elevation, thus reducing the clear opening of the spillway. As previously mentioned in Section 5.1a, a new gravel roadway has been constructed across the former auxiliary spillway, thus precluding its use as an outlet. It has been suggested in this report that the road embankment be removed in order to restore this overflow device to its former status.

d. Overtopping Potential

If both spillways remain in their present configuration the dam would be overtopped by 1.52 feet in the event of a 100-year storm.

e. Drawdown

An 18-inch-diameter, gate operated, cast iron pipe is available for drawing down the lake to elevation 87.5 in approximately 5 days.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

In view of the relatively young age of the dam embankment and the conservatively designed and apparently well-supervised construction, the dam is considered to be in a good overall condition. There is no evidence of subgrade subsidence or slumping, and the main embankment crest and adjoining cut slopes along the auxiliary spillway are at true design grade and are marred only by minor grading undulation and the roadway obstructing the auxiliary spillway channel. The inspection team noted some signs of apparent seepage at the downstream toe, but this was deemed to be of minor importance with respect to the structural integrity of the dam. In summary, nothing was visually noted that would create or make worse a hazardous condition that could not be readily corrected.

b. Design and Construction Data

From the review of the contract plans for the initial construction, the design appears to be well engineered, reflects a conservative approach, and employs conventional analytical techniques. Based on the condition of the dam and the hazard classification, it is believed that additional design studies are unnecessary under the purview of Public Law 92-367.

c. Operating Records

The performance of this structure has been satisfactory since its completion, although normal embankment maintenance and concrete repairs appear to have been neglected. There are no records available of operations, maintenance, or inspections since the original construction was completed.

d. Post Construction Changes

Several modifications were noted that are not depicted on any of the design drawings and that severely reduce the discharge capacity of the spillways. A 12-inch-high flashboard and a bridge have been added to the primary spillway. The bridge soffit extends 0.67 feet below the dam crest, constricting the clear opening substantially. The combined constriction presented by the

flashboard and bridge soffit decreases the primary spillway's maximum discharge capacity from about 725 cfs to 317 cfs. The road construction across the auxiliary spillway at the right abutment completely blocks the channel, reducing that spillway's discharge capacity from approximately 300 cfs to zero.

e. Seismic Stability

Herzenberg Dam is located in Seismic Zone 1 in which seismic activity is slight and the additional structural loading imparted thereby is generally insignificant. Experience indicates that earthen dams in Zone 1 that are stable under static loading conditions will maintain their structural integrity when subjected to the negligible dynamic loads imposed by the weak seismicity characteristic of this area. This dam is considered to be structurally stable under static loading conditions.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ REMEDIAL ACTIONS

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, Herzenberg Dam is judged to be in a good overall condition, although the spillways as presently constituted are incapable of transmitting the design flood. No detrimental conditions of a structural nature were observed, and while overtopping could cause severe damage to the dam itself, there is little downstream that would be endangered by a dam failure. It is recommended that the dam be downgraded to a low hazard classification.

b. Adequacy of Information

The information available is considered adequate with respect to the analyses and evaluation of the continuing safe operation and structural stability of this dam.

c. Urgency

The remedial actions described below could be undertaken by the owner in the future to ensure the continued functioning of the dam and its impoundment.

d. Necessity for Further Study

In view of the overall condition of this dam and its low hazard classification additional studies within the purview of Public Law 92-367 are considered unnecessary.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Recommendations

The spillways, as presently constricted, can accommodate only 13.5 percent of the design storm runoff. There are three relatively simple spillway modifications which will increase the spillway capacity.

It is suggested that one or more of the following changes be made:

- Remove the flashboard on the primary spillway.

- Raise the bridge to a point where its soffit is above the dam crest elevation.

- Remove the gravel road embankment presently blocking the auxiliary spillway.

It is further recommended that the following remedial work be performed some time in the future:

- Fill, regrade, and reseed the eroded embankment areas and add riprap at the new higher water line on the upstream slope.

- Remove the thickets, brush, and saplings from both slopes.

- Resurface the areas of spalled concrete at the primary spillway.

- Provide weepholes at the bottom of both wingwalls on the right side of the spillway to relieve the hydrostatic pressure and monitor these wingwalls for further movement.

- Monitor the seepage near the left abutment for movement of fine material and to ascertain that the seepage is not flowing through the dam.

b. O&M Maintenance and Procedures

In view of the assessment contained herein, no additional procedures other than those previously described and normal maintenance appear to be required. While a downstream warning system is considered unnecessary, the owner should develop a periodic inspection and maintenance program whereby any further deterioration could be noted and corrective measures undertaken. It is further recommended that the low level drain be opened several times a year to ensure its proper functioning.

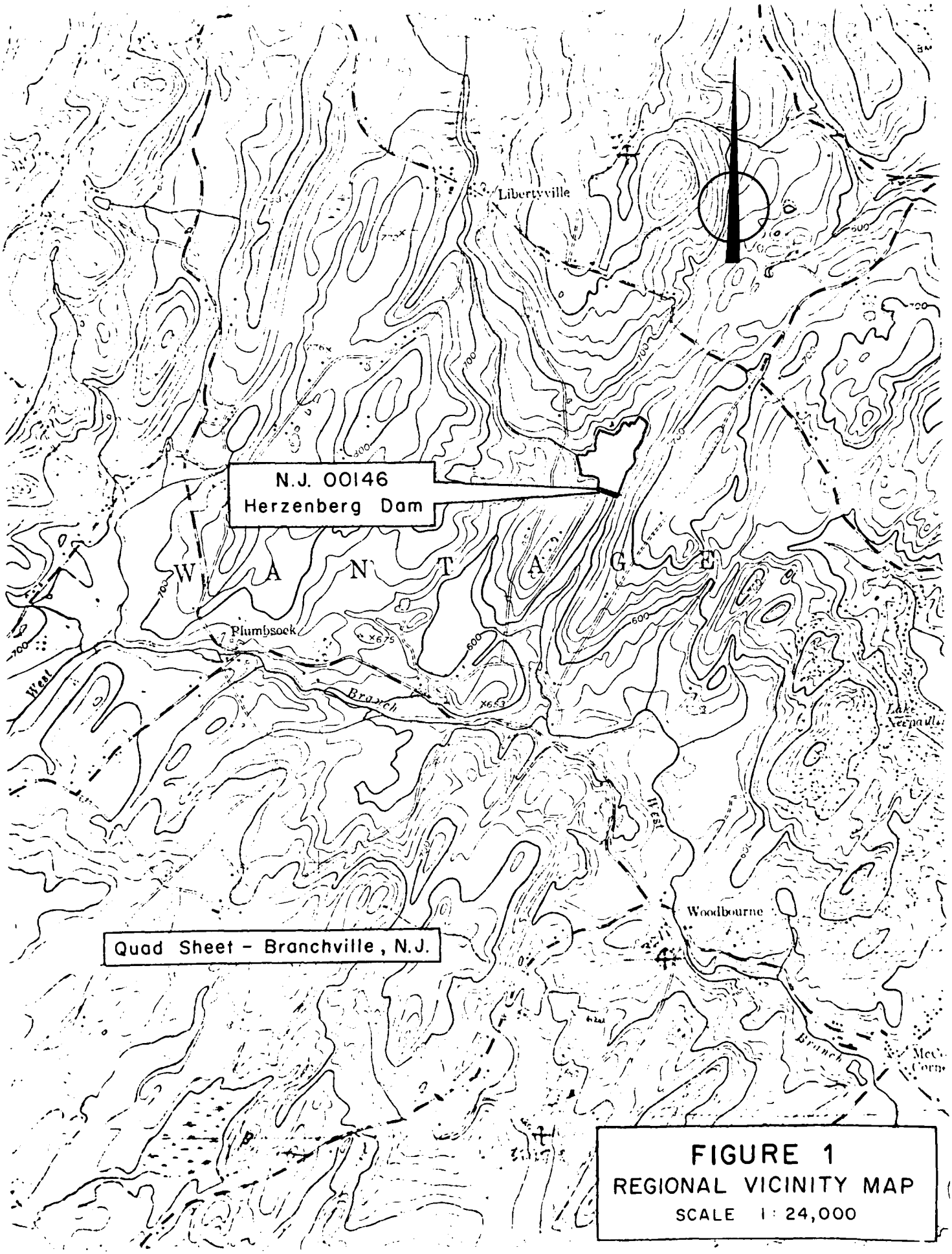
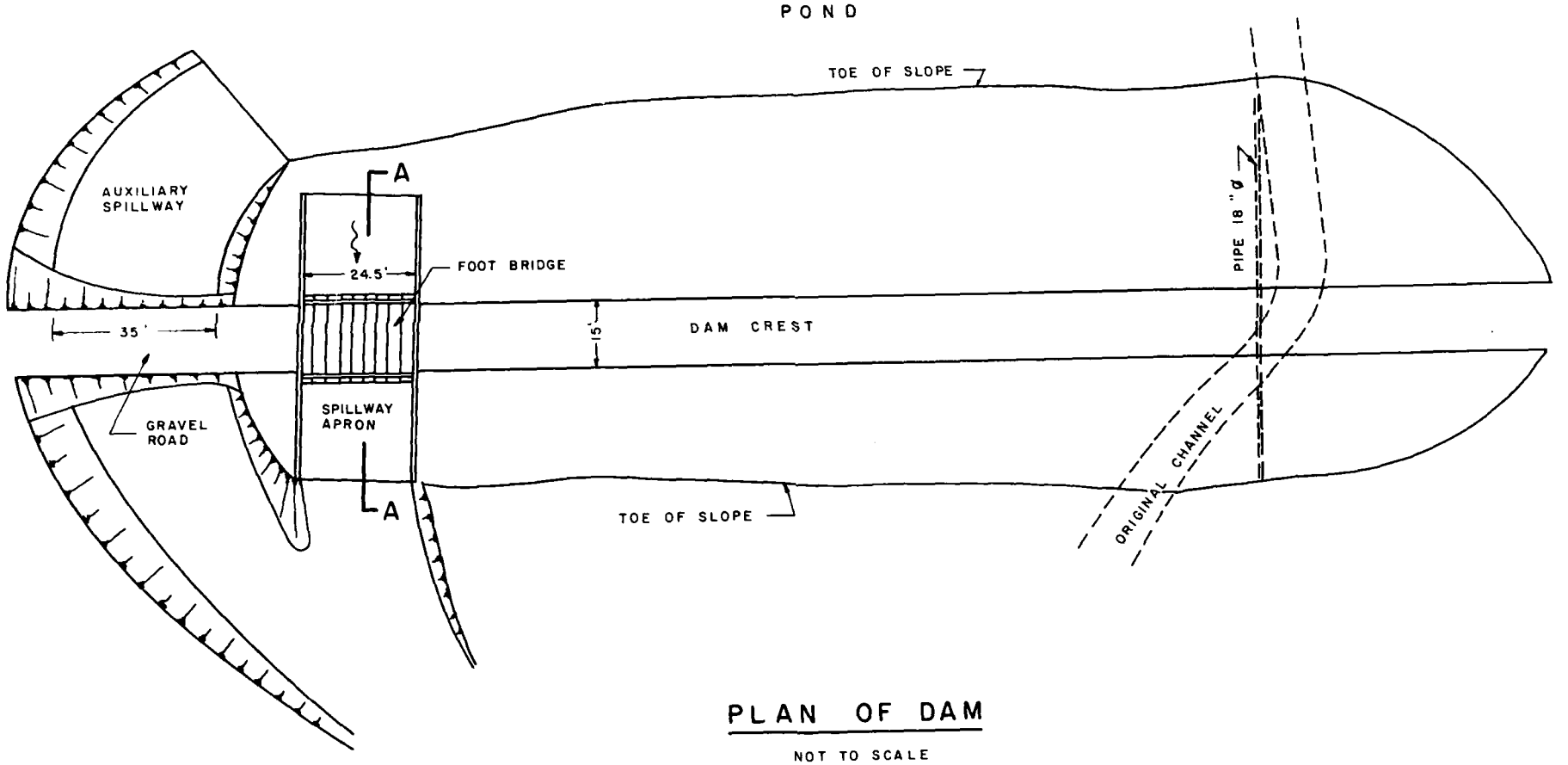


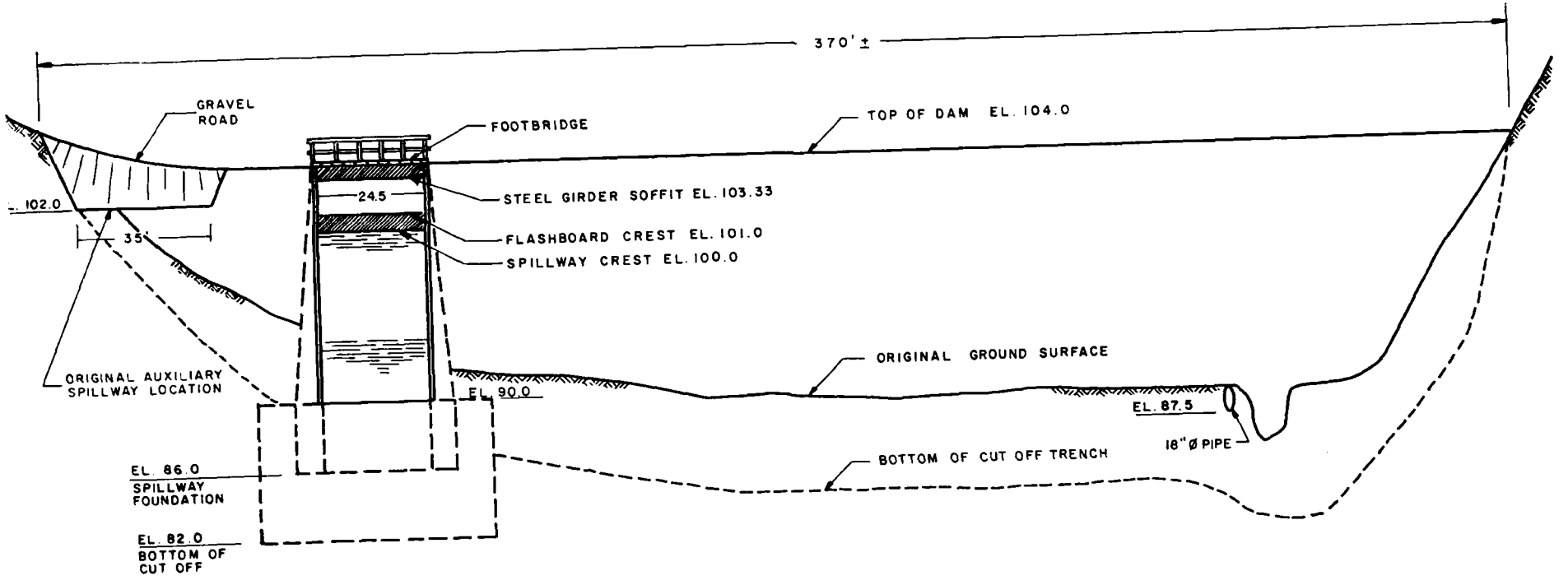
FIGURE 1
REGIONAL VICINITY MAP
SCALE 1 : 24,000



PLAN OF DAM

NOT TO SCALE

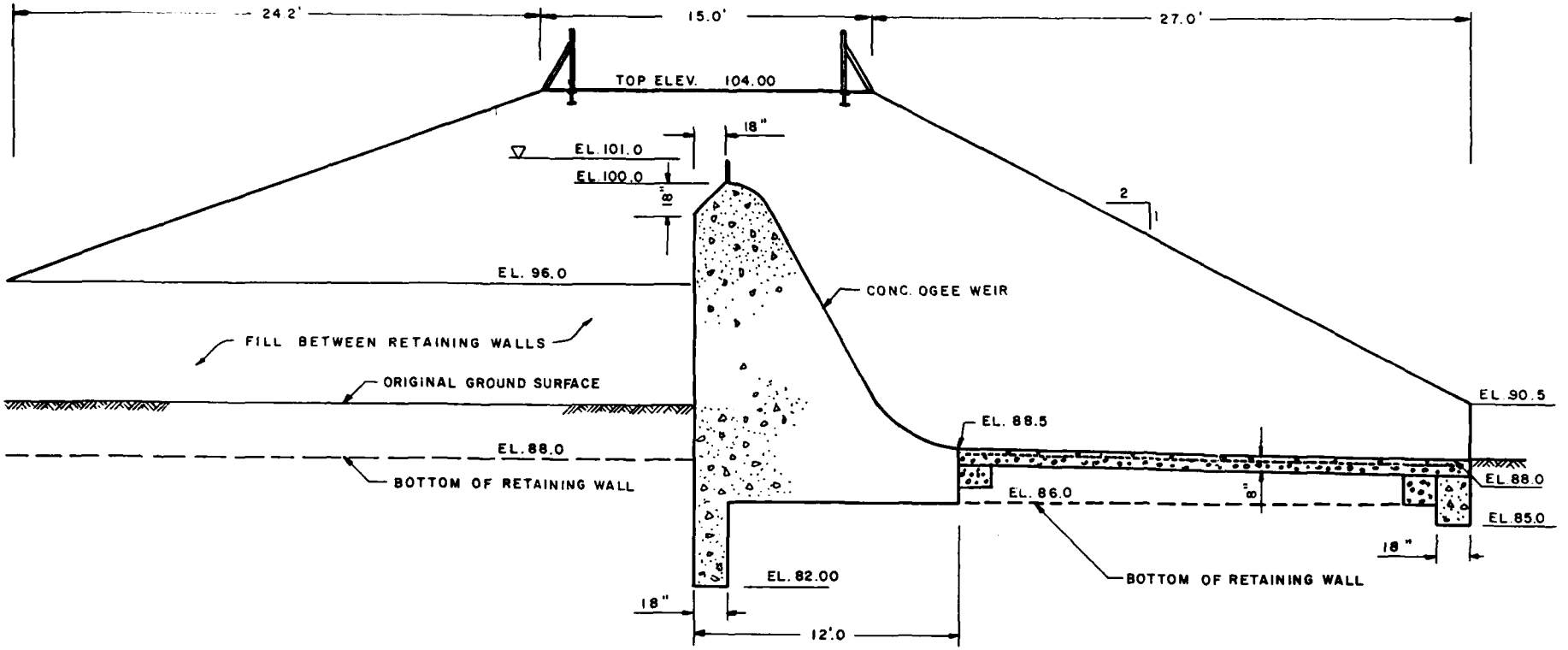
HERZENBERG DAM
FIGURE 2



PROFILE ALONG ℄ OF DAM

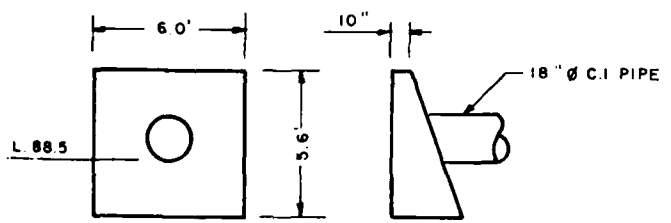
NOT TO SCALE

HERZENBERG DAM
FIGURE 3



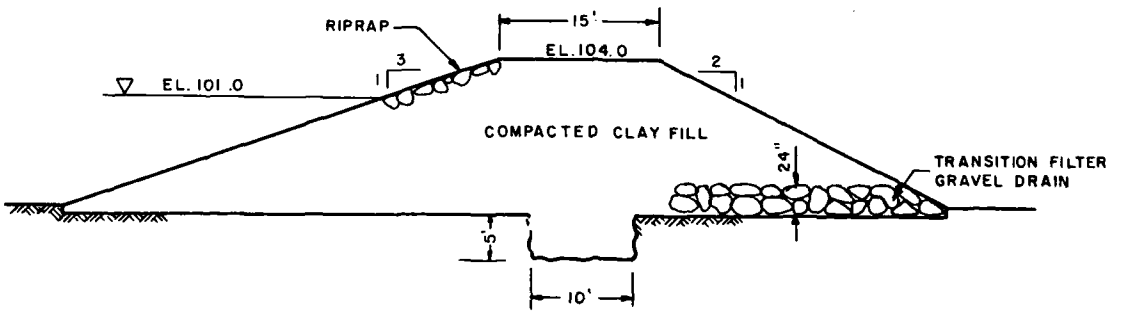
SECTION A-A

NOT TO SCALE



OUTLET HEADWALL

NOT TO SCALE



TYPICAL SECTION OF DAM

NOT TO SCALE

HERZENBERG DAM

FIGURE 4

Check List
Visual Inspection
Phase 1

Name Dam Herzenberg Dam County Sussex State New Jersey Coordinators NJDEP

Date(s) Inspection 3/26/81 Weather Clear Temperature 55°F

Pool Elevation at Time of Inspection 101± AD* Tailwater at Time of Inspection 89± AD*

Inspection Personnel:

T. Chapter LBAI

A. Perara LBAI

J. Moyle NJDEP

T. Chapter Recorder

No representative of
owner present.

* AD - Assumed Datum

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None Observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None Observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Light erosion leading to outlet valve. Upstream slope irregular and almost vertical due to wave action.	Fill and reseed eroded areas, replace upstream riprap.
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Slight undulation of crest. 11' wide gravel road built along crest of dam and across auxiliary spillway channel.	
RIPRAP FAILURES	No riprap observed. Stone protection noted in plans apparently below present water line.	Additional stone should be placed to reach new, higher water elevation.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Light brush and small trees (less than 6" dia.) on both slopes.	Remove all excess vegetation.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Dam grades smoothly into sloping abutment areas.	
ANY NOTICEABLE SEEPAGE	Seepage about 12' beyond toe at left abutment extending along abutment. Damp area downstream of center of dam's toe.	Seepage at abutment seems to be coming from adjoining hill rather than through dam. Should be monitored.
STAFF GAGE AND RECORDER	None	
DRAINS	Stone toe drain not visible but reported on plans.	Outlet channel filled with water indicating drain is functioning effectively and conducting seepage to low outlet channel as designed.

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N/A	
INTAKE STRUCTURE	Not Observed	
OUTLET STRUCTURE	18" dia. steel pipe with gate valve stem and wheel. Is operable although chained shut. Large pool of running water, so valve may be partially open. Water may also be from toe drain.	
OUTLET CHANNEL	Flows into main spillway discharge channel. Wide natural valley, heavily forested.	
EMERGENCY GATE	Wheel and valve housing tilted 20^{o} from vertical. Wheel turns as far as chain allows. Control component is rusty but in good operable condition.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Spalling along entire length of crest where discharge over flashboard hits weir. Spalled area 4" to 8" wide x 1" deep. Spalling in narrow line across middle of spillway. Light spalling on both wingwalls. Seepage through right wingwall at midheight.	48" Flash. to Planks. 12" Flashbd. Bridge girders 20" wide. Clear opening-2.33'. Spalled areas should be repaired.
APPROACH CHANNEL	Concrete wingwalls extending 25' into lake from bridge. Right wingwalls both displaced 0.5" from spillway sidewall.	Water depth of 4 feet upstream of weir as indicated on plans. Weep holes should be installed in right wingwalls and their displacement should be monitored.
DISCHARGE CHANNEL	Spillway apron discharging into natural channel.	
BRIDGE AND PIERS	12.25' wide bridge over spillway. Clear opening between flashboard and soffit is 2.33'.	Bridge may have to be elevated 0.66 feet. (See text, Section 7.2)
GATES AND OPERATIONAL EQUIPMENT	12" flashboard.	Flashboard may have to be removed. (See text, Section 7.2)

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	None	
APPROACH CHANNEL	Vegetated, negatively sloped approach channel to auxiliary spillway at right abutment.	
DISCHARGE CHANNEL	Vegetated, positively sloped channel discharges into principal spillway channel.	
BRIDGE AND PIERS	Road constructed across spillway is completely blocking channel and making it useless.	Road should be removed or bridged over channel.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle (approx. 4:1) covered with light to heavy woods. Private property undeveloped except for owner's house.	
SEDIMENTATION	None Observed	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Flat slope channel approx. 10 feet wide and 1-2 feet deep. Occasional small boulders present.	
SLOPES	Flat, swampy, and lightly to densely wooded downstream slope.	
APPROXIMATE NO. OF HOMES AND POPULATION	None	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available - Microfilm - NJDEP Prospect Street, Trenton, New Jersey
REGIONAL VICINITY MAP	Available USGS, Branchville, New Jersey Quadrangle.
CONSTRUCTION HISTORY	Not Available
TYPICAL SECTIONS OF DAM	Available, NJDEP
HYDROLOGIC/HYDRAULIC DATA	Available, NJDEP
OUTLETS - PLAN	Available, NJDEP
- DETAILS	Available, NJDEP
-CONSTRAINTS	Not Available
-DISCHARGE RATINGS	Not Available
RAINFALL/RESERVOIR RECORDS	Not Available

ITEM	REMARKS
SPILLWAY PLAN	Available, NJDEP
SECTIONS	Available, NJDEP
DETAILS	Available, NJDEP
OPERATING EQUIPMENT PLANS & DETAILS	Available, NJDEP

ITEM	REMARKS
DESIGN REPORTS	Available, NJDEP
GEOLOGY REPORTS	Not Available
DESIGN COMPUTATIONS	Not Available
HYDROLOGY & HYDRAULICS	Not Available
DAM STABILITY	Not Available
SEEPAGE STUDIES	Not Available
MATERIALS INVESTIGATIONS	Not Available
BORING RECORDS	Not Available
LABORATORY	Not Available
FIELD	Not Available
POST-CONSTRUCTION SURVEYS OF DAM	Not Available
BORROW SOURCES	Not Available

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	Description available-NJDEP Several modifications with no records.
HIGH POOL RECORDS	Not Available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None Available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE	Not Available
OPERATION	Not Available
RECORDS	Not Available

March , 1981

Principal Spillway

March , 1981

View of Road Obstructing Auxiliary Spillway

March , 1981

Crest of Dam Looking West

March , 1981

Downstream Face of Dam

March ,1981

18" Ø Outlet and Valve

March ,1981

Downstream Channel

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 2.4 sq. mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 101 A.D. (113± acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): NA

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 104 A.D. (180± acre-feet)

CREST: Primary/Auxiliary Spillway

a. Elevation 110 A.D./112 A.D.
b. Type Concrete ogee weir/Vegetated channel
c. Width 24.5 feet/35 feet
d. Length 2 feet/Approximately 100 feet
e. Location Spillover 50' from right abutment/At right abutment
f. Number and Type of Gates 1' Flashboard on primary spillway

OUTLET WORKS:

a. Type 18"-dia. steel pipe
b. Location 100 feet from left abutment
c. Entrance inverts Unknown
d. Exit inverts 87.5 A.D.
e. Emergency draindown facilities Gate wheel at downstream toe

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 317 cfs

A.D. - Assumed Datum

BY_____ DATE 1-31

CHKD. BY_____ DATE_____

SUBJECT Time Of Concentration

LOUIS BERGER & ASSOCIATES INC.

Harrisburg Dam

SHEET NO. A1 OF A15

PROJECT 66-276

1.- Length along watercourse = 13,000 ft. (2.46 mi)

ΔH = 200 ft. Slope = $\frac{200' \times 100}{13,000'}$ = 1.5 %

Assume channel velocity of 2 fps ∴ $t_c = \frac{13,000'}{2 \times 3600}$ = 1.81 hr.

Length of overland flow = 3,900 ft.

ΔH = 520 ft. Slope = $\frac{520' \times 100}{3,900'}$ = 13.3 %

Assume overland velocity of 3.5 fps ∴ $t_c = \frac{3,900'}{3.5 \times 3600}$ = 0.31 hr.

Total t_c = 1.81 hr + 0.31 hr = 2.12 hrs.

2.- California Culverts Methodology Standard Tc: $\left[\frac{11.9\,L^3}{H}\right]^{0.385}$

$t_c = \left(\frac{11.9 \times 2.46^3}{200}\right)^{0.385}$ = 0.95 hrs

t_c overland flow Same as above t_c = 1.81 hr ∑ t_c .95+1.81 = 1.26

3.- SCS Methodology

Assume C_n for watershed = 60

Litchess, Dover, Gloucester soils - All group B

25 % woods (C_n - 55); 75 % good pasture (C_n - 61)

Slope = 4.3 %

L = 16,700'

$$L_{og} = \frac{L^{0.8}(S+1)^{0.7}}{1900\,y^{0.5}} = \frac{16,700^{0.8}(7.67)^{0.7}}{1,900\,(4.3)^{0.5}} = 2.55 \text{ hr.}$$

t_c = Log/0.6 = 4.25 hrs

Avg. t_c = $\frac{2.12 \text{ hr} + 1.26 + 4.25}{3}$ = 2.54 hrs

$T_p = D/2 + 0.6\,t_c = 0.25/2 + 0.6\,(2.54) = 1.65$ hrs

Lag Time = $.6\,t_c = .6 \times 2.54 = 1.52$ hrs

BY ____ DATE ____ **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A2 OF A12

CHKD. BY ____ DATE ____ Herzenberg Lake Dam PROJECT ____

SUBJECT ____

Precipitation data from TP-40 & NOAA Technical Memorandum NWS Hydro -35

Time	Precipitation	Δ	Rearranged Δ
0.25	1.66	1.66	0.06
0.50	2.30	0.64	0.07
0.75	2.70	0.40	0.07
1.00	3.00	0.30	0.08
1.25	3.25	0.25	0.09
1.50	3.44	0.19	0.10
1.75	3.60	0.16	0.11
2.00	3.75	0.15	0.13
2.25	3.89	0.14	0.15
2.50	4.02	0.13	0.19
2.75	4.14	0.12	0.30
3.00	4.25	0.11	0.64
3.25	4.35	0.10	1.66
3.50	4.45	0.10	0.40
3.75	4.54	0.09	0.25
4.00	4.63	0.09	0.16
4.25	4.71	0.08	0.14
4.50	4.79	0.08	0.12
4.75	4.87	0.08	0.10
5.00	4.94	0.07	0.09
5.25	5.01	0.07	0.08
5.50	5.08	0.07	0.08
5.75	5.14	0.06	0.07
6.00	5.20	0.06	0.06

BY J. Cerech DATE April '81 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A-3 OF A-15

CHKD. BY ____ DATE ____ Herzberg Dam PROJECT C-C-2116

SUBJECT Spillway Stage - Discharge w/o Auxillian Spillway

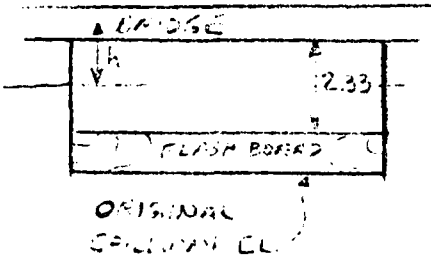
W.S. TO CLEV. 103.3 AL $Q = CLH^{3/2}$: C = Variable

CREST ABOVE 103.3 AL $Q = CA\sqrt{2gh}$: C = .6

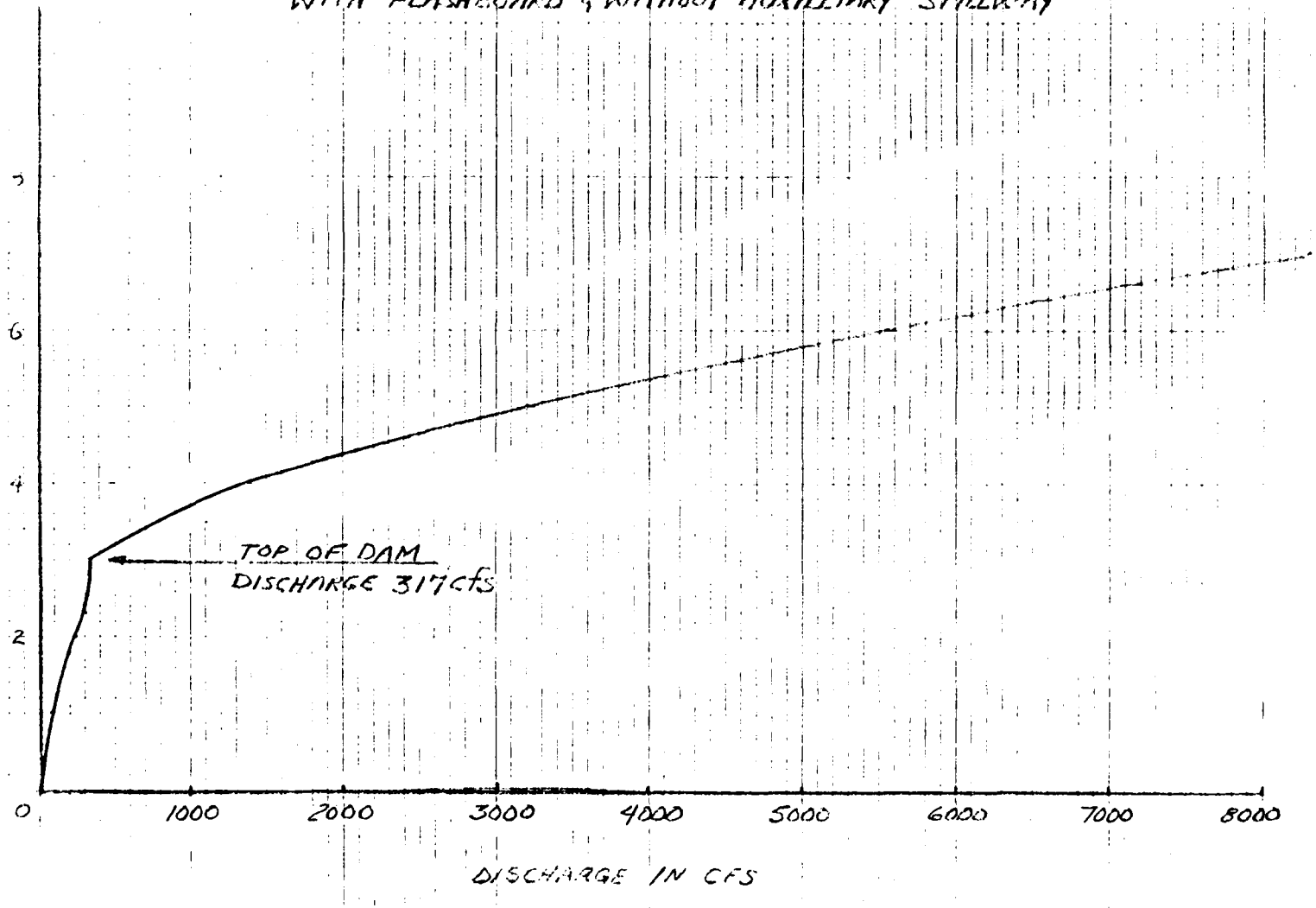
	FLOW OVER Spillway Crest L = 24.2' CL. 100 w/o Flashboard CL. 101 AL WITH Flashboard				FLOW OVER DAM CL. 104 AL L = 10'			TOTAL FLOW
ELEV.	H	C	h	Q	H	C	Q	ΣQ
RESERVOIR DATUM			ORIFICE					
100	0							
101	0							
102	1	3.2		78				78
103	2	3.4		236				236
103.3	2.3	3.5		299				299
104	3	.6	1.33	317	0	*		317
105	4	.6	2.33	420	1	3.09	959	1379
106	5	.6	3.33	502	2	↓	2709	3211
107	6	.6	4.33	572	3		4977	5549
108	7	.6	5.33	635	4		7663	8298

* FROM DESIGN CALCS

FOR ORIFICE FLOW



HONEYCOMB DAM
STAGE DISCHARGE CURVE
WITH FLASHBOARD & WITHOUT AUXILLIARY SPILLWAY



A4 OF A15

BY ____ DATE Jan '81 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A5 OF A12

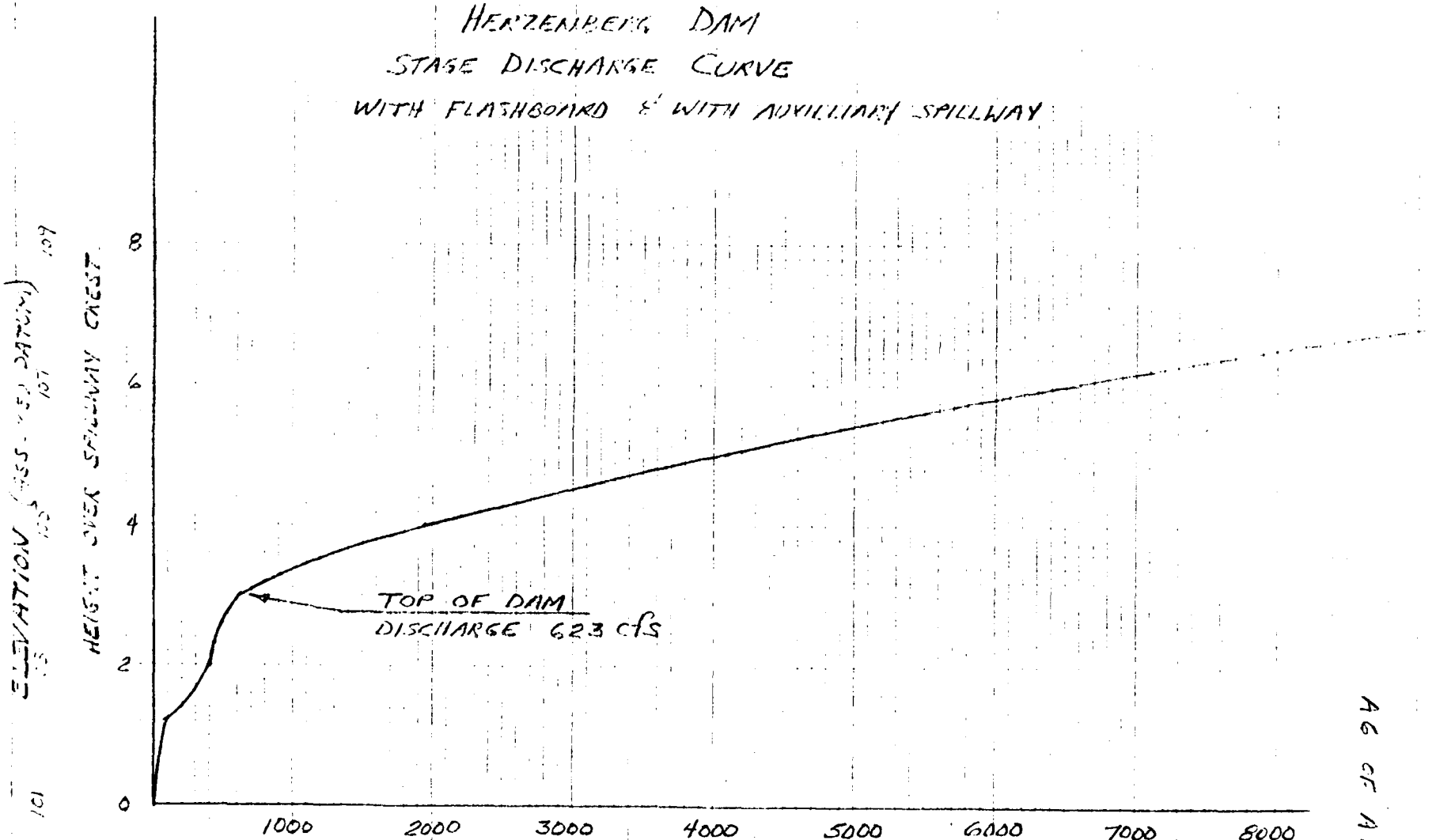
CHKD. BY ____ DATE March '81 Herzenberg Dam PROJECT 66-276

SUBJECT Stage Discharge WITH AUXILIARY SPILLWAY

	$Q = CLH^{3/2}$ Flow over Spillway Crest $L = 24.5'$ El. -100 w/FB El. 101 WITH FLASH BD.			$Q = CLH^{3/2}$ Auxiliary Spillway $L = 35'$ El. -102			$Q = CLH^{1/2}$ Over Dam $L = 310'$ El. - 104			
EL	H	C	h	Q	H	C	Q	H	C	Q	ΣQ
100	-										
101	0										
102	1	3.2		78	0	*3.09					78
103	2	3.4		236	1		108				396
103.3	2.3	3.5		299	1.3		160				459
104	3		1.33	317	2		306	0			623
105	4		2.33	420	3		562	1	3.09*	958	1740
106	5		3.33	502	4		865	2		2709	4075
107	6		4.33	572	5		1309	3		4977	6558
108	7		5.33	635	6		1889	4		7563	9957

* From design calcs.

HERZENBERG DAM
STAGE DISCHARGE CURVE
WITH FLASHBOARD & WITH AUXILLIARY SPILLWAY



BY _____ DATE Jan 81 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A-7 OF A-12

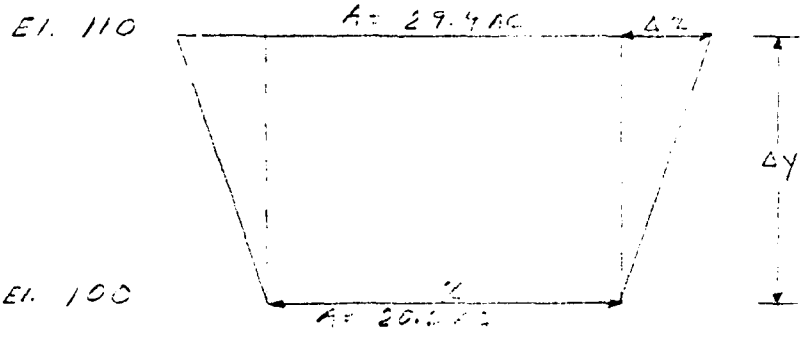
CHKD. BY _____ DATE _____ Harrisburg, Pa. PROJECT 66-4012

SUBJECT Surcharge Storage

Area of lake @ el. 110 NGVD (100 AD)* = 20.2 Ac

Area at 625' contour (110 AD) 29.4 ac.

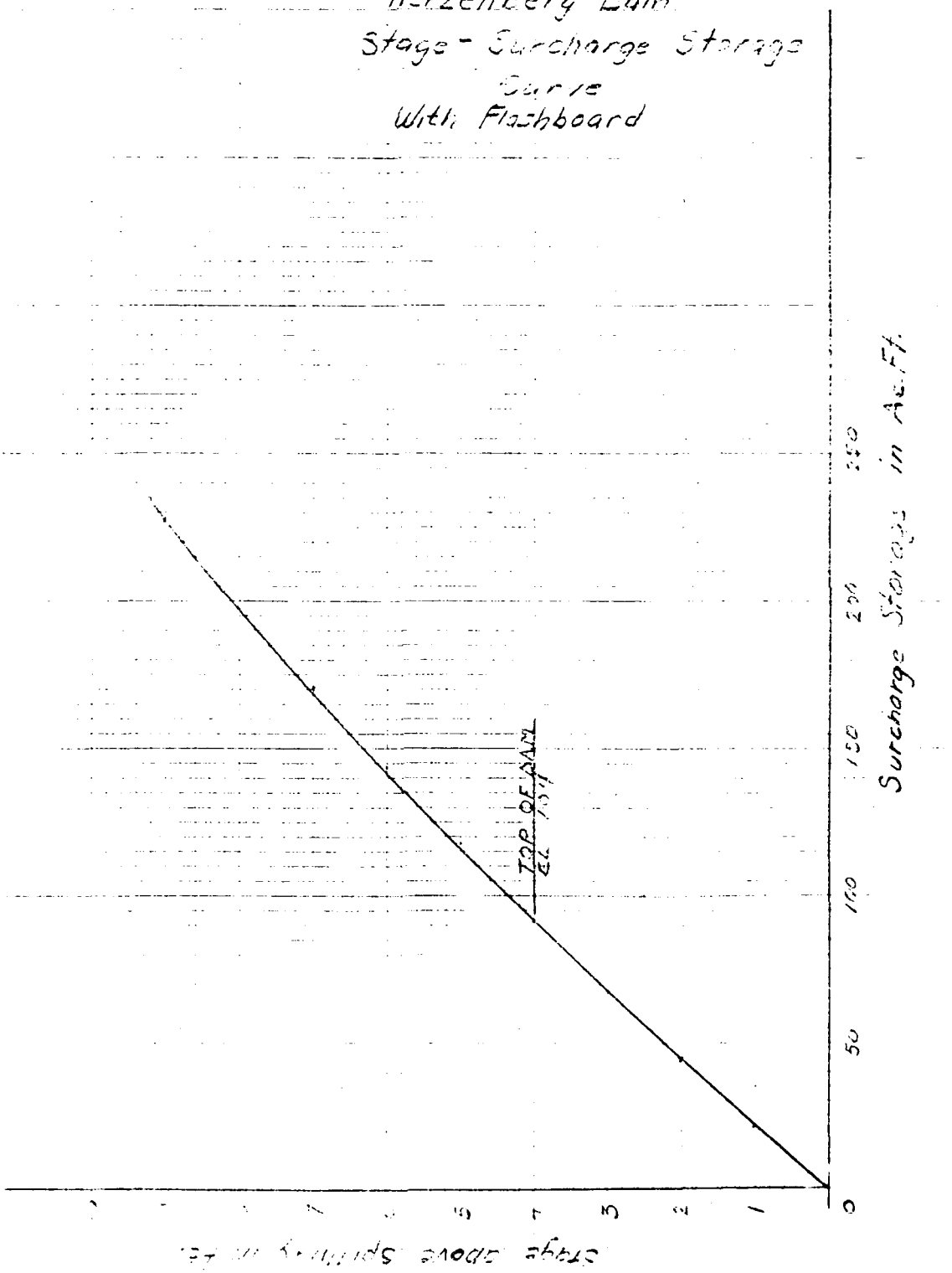
Δ Surcharge = Δx (x + Δx)



Elev. AD	Ht above Spillway (Δx)	Ht. above Flashboard (x - Δx)	(x) (ac)	Surcharge Storage without Flashboard (ac. ft.)	Surcharge Storage with Flashboard (ac. ft.)
100	0	-	0	0	-
101	1	0	20.7	20.7	0
102	2	1	21.1	42.2	21.5
103	3	2	21.6	64.8	44.1
104	4	3	22.0	88	67.3
105	5	4	22.5	112.5	91.3
106	6	5	23.0	138	117.3
107	7	6	23.4	163.8	143.1
108	8	7	23.9	191.2	170.5
109	9	8	24.3	218.7	198.0
110	10	9	24.8	248	227.3

* NGVD elevation datum of lake estimated on basis of slope of original stream course and upstream extent of lake edge.

Herzenberg Dam
Stage - Surcharge Storage
Curve
With Flashboard



BY _____ DATE _____ **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A9 OF A15

CHKD. BY _____ DATE _____ Harrisonburg, VA PROJECT 66

SUBJECT Summary Existing Conditions

El. W.S.	Ht. above Spillway (ft.)	Ht. above Flashboard (ft.)	Surcharge Storage (ac-ft.)	Discharge w/o dam. Spillway (cfs)
100	0	-		
101	1	0	0	0
102	2	1	21.5	79
103	3	2	44.1	230
103.3	3.3	2.3		299
104	4	3	67.3	317
105	5	4	91.5	1379
106	6	5	117.3	3211
107	7	6	143.1	5549
108	8	7	171.5	8299

BY _____ DATE Dec. 81
CHKD. BY _____ DATE _____
SUBJECT _____

LOUIS BERGER & ASSOCIATES INC.

Horizon Lake

SHEET NO. A-14 OF A-15
PROJECT _____

Drawdown by 18" ϕ C.M. pipe

Normal pool elev. = 100
Inlet invert elev. = 88.5
Exit invert elev. = 87.5
Total drawdown head = 12.5' (measured to top of conduit at exit)

Assume inflow of 1 cfs/sq.mile of D.A. ∴ inflow = 2.4 cfs

From Dam Application:
Vol. of lake = 30 mil. gals (92.4 ac.ft.)

$$Q = A\sqrt{\frac{2gh}{K_t}}$$

$A = 1.77^{sq.ft.}$
$h_{avg.} = 10.5'/2 = 5.25'$
$K_t = \Sigma K_e, K_c, K_v = 1.5 + 5.12 + 1.0 = 7.62$

$$Q = 1.77\sqrt{64.4 \times 5.25/7.62} = 11.6 \text{ cfs}$$

$$Q = 11.6 \text{ cfs} - 2.4 \text{ cfs} = 9.4 \text{ cfs}$$

$$\text{Drawdown time} = \frac{92.4 \text{ ac ft} \times 43{,}560 \text{ ft}^3/\text{ac}}{9.4 \text{ cfs} \times 3600} = 118.9 \text{ hrs.}$$

Drawdown time = 5.0 days

K_e = entrance loss coefficient for square edge

K_c = conduit loss coefficient $= 29(.024)^2 \frac{84}{.33^{4/3}} = 5.12$

K_v = exit velocity loss coefficient = 1.0

BY J.C. DATE 6/4/81 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A11 OF A15

CHKD. BY _____ DATE _____ HERZENBERG LAKE DAM PROJECT CC276

SUBJECT HEC1 DB

```
A1  HERZENBERG LAKE DAM HEC-1 DB
A2  J. CERAVOLO
A3  JUNE 4 1981
B     100       0      15       0       0       0       0       0       0       0
B1      3                                                 1
K       0       1
K1  INFLOW HYDROGRAPH TO RESERVOIR
M       0       2    2.39
O      24
O1   .06     .07     .07     .08     .09     .10     .11     .13     .15     .19
O1   .30     .64    1.66     .40     .25     .16     .14     .12     .10     .09
O1   .09     .08     .07     .06
T                                                       0.5     0.1
W2             1.52
X       0       0       1
K       1       2                                       1
K1  ROUTED FLOW THROUGH RESERVOIR
Y                                       1
Y1      1                                               0      -1
Y4    101     102     103   103.3     104     105     106     107     108
Y5      0      78     235     299     317    1378    3211    5549    8298
$S      0   170.5
$E    101     108
$$    101
$D    104
K      99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
END OF NETWORK	

SUB-AREA RUNOFF COMPUTATION

PRECIP DATA

NP	STORM	DAJ	DAK
24	0.00	0.00	0.00

TC= 0.00 LAG= 1.52

RECESSION DATA

STRTQ= 0.00 GRCSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH 32 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= 1.52 VOL= 1.00

47.	137.	280.	472.	621.	695.	697.	645.	565	460
342.	264.	205.	164.	128.	99.	77.	61.	47	36
29	23.	18.	14.	11.	8.	7.	6.	4	3
2.	1.								

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
**********	**********	**********	**********	**********

HYDROGRAPH ROUTING

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	-1

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
**********	**********	**********	**********	**********

PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
**********	**********	**********	**********	**********

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	15	0	0	0	0	0	0	0
			JOPER	NWT	LROPT	TRACE			
			3	0	0	0			

INFLOW HYDROGRAPH TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	2	2.39	0.00	2.39	0.00	0.000	0	0	0

PRECIP PATTERN

0.06	0.07	0.07	0.08	0.09	0.10	0.11	0.13	0.15	0.19
0.30	0.64	1.66	0.40	0.25	0.16	0.14	0.12	0.10	0.09
0.08	0.08	0.07	0.06						

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	0.50	0.10	0.00	0.00

UNIT HYDROGRAPH DATA

0

END-OF-PERIOD FLOW

MO DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	0.15	1	0.06	0.00	0.06	0.	1.01	12.45	51	0.00	0.00	0.00	1
1.01	0.30	2	0.07	0.00	0.07	0.	1.01	13.00	52	0.00	0.00	0.00	0
1.01	0.45	3	0.07	0.00	0.07	0.	1.01	13.15	53	0.00	0.00	0.00	0
1.01	1.00	4	0.08	0.00	0.08	0.	1.01	13.30	54	0.00	0.00	0.00	0
1.01	1.15	5	0.09	0.00	0.09	0.	1.01	13.45	55	0.00	0.00	0.00	0
1.01	1.30	6	0.10	0.00	0.10	0.	1.01	14.00	56	0.00	0.00	0.00	0
1.01	1.45	7	0.11	0.06	0.05	3.	1.01	14.15	57	0.00	0.00	0.00	0
1.01	2.00	8	0.13	0.10	0.03	13.	1.01	14.30	58	0.00	0.00	0.00	0
1.01	2.15	9	0.15	0.12	0.03	37.	1.01	14.45	59	0.00	0.00	0.00	0
1.01	2.30	10	0.19	0.16	0.03	83.	1.01	15.00	60	0.00	0.00	0.00	0
1.01	2.45	11	0.30	0.27	0.03	158.	1.01	15.15	61	0.00	0.00	0.00	0.
1.01	3.00	12	0.64	0.61	0.03	280.	1.01	15.30	62	0.00	0.00	0.00	0.
1.01	3.15	13	1.66	1.63	0.03	509.	1.01	15.45	63	0.00	0.00	0.00	0.
1.01	3.30	14	0.40	0.37	0.03	845.	1.01	16.00	64	0.00	0.00	0.00	0.
1.01	3.45	15	0.25	0.22	0.03	1285.	1.01	16.15	65	0.00	0.00	0.00	0.
1.01	4.00	16	0.16	0.13	0.03	1770.	1.01	16.30	66	0.00	0.00	0.00	0.
1.01	4.15	17	0.14	0.11	0.03	2145.	1.01	16.45	67	0.00	0.00	0.00	0.
1.01	4.30	18	0.12	0.09	0.03	2343.	1.01	17.00	68	0.00	0.00	0.00	0
1.01	4.45	19	0.10	0.07	0.03	2363.	1.01	17.15	69	0.00	0.00	0.00	0
1.01	5.00	20	0.09	0.06	0.03	2245.	1.01	17.30	70	0.00	0.00	0.00	0.
1.01	5.15	21	0.08	0.05	0.02	2037.	1.01	17.45	71	0.00	0.00	0.00	0.
1.01	5.30	22	0.08	0.05	0.02	1763.	1.01	18.00	72	0.00	0.00	0.00	0.
1.01	5.45	23	0.07	0.04	0.02	1472.	1.01	18.15	73	0.00	0.00	0.00	0
1.01	6.00	24	0.06	0.03	0.02	1238.	1.01	18.30	74	0.00	0.00	0.00	0
1.01	6.15	25	0.00	0.00	0.00	1045.	1.01	18.45	75	0.00	0.00	0.00	0.
1.01	6.30	26	0.00	0.00	0.00	887.	1.01	19.00	76	0.00	0.00	0.00	0.
1.01	6.45	27	0.00	0.00	0.00	745.	1.01	19.15	77	0.00	0.00	0.00	0
1.01	7.00	28	0.00	0.00	0.00	616.	1.01	19.30	78	0.00	0.00	0.00	0.
1.01	7.15	29	0.00	0.00	0.00	504.	1.01	19.45	79	0.00	0.00	0.00	0
1.01	7.30	30	0.00	0.00	0.00	407.	1.01	20.00	80	0.00	0.00	0.00	0
1.01	7.45	31	0.00	0.00	0.00	324.	1.01	20.15	81	0.00	0.00	0.00	0.
1.01	8.00	32	0.00	0.00	0.00	254.	1.01	20.30	82	0.00	0.00	0.00	0
1.01	8.15	33	0.00	0.00	0.00	199.	1.01	20.45	83	0.00	0.00	0.00	0
1.01	8.30	34	0.00	0.00	0.00	155.	1.01	21.00	84	0.00	0.00	0.00	0.
1.01	8.45	35	0.00	0.00	0.00	121.	1.01	21.15	85	0.00	0.00	0.00	0.
1.01	9.00	36	0.00	0.00	0.00	95.	1.01	21.30	86	0.00	0.00	0.00	0

BY J.C. DATE 6/[illegible]

CHKD. BY _____ DATE _____

SUBJECT [illegible] HEC-1 OUT

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. [illegible] OF [illegible]

PROJECT [illegible]

1 01	9.15	37	0.00	0.00	0.00	74.	1 01	21.45	87	0.00	0.00	0.00	0.
1 01	9.30	38	0.00	0.00	0.00	58.	1 01	22.00	88	0.00	0.00	0.00	0.
1 01	9.45	39	0.00	0.00	0.00	46.	1 01	22.15	89	0.00	0.00	0.00	0.
1 01	10.00	40	0.00	0.00	0.00	36.	1 01	22.30	90	0.00	0.00	0.00	0.
1 01	10.15	41	0.00	0.00	0.00	28.	1 01	22.45	91	0.00	0.00	0.00	0.
1 01	10.30	42	0.00	0.00	0.00	21.	1 01	23.00	92	0.00	0.00	0.00	0.
1 01	10.45	43	0.00	0.00	0.00	15.	1 01	23.15	93	0.00	0.00	0.00	0.
1 01	11.00	44	0.00	0.00	0.00	10.	1 01	23.30	94	0.00	0.00	0.00	0.
1 01	11.15	45	0.00	0.00	0.00	6.	1 01	23.45	95	0.00	0.00	0.00	0.
1 01	11.30	46	0.00	0.00	0.00	4.	1 02	0.00	96	0.00	0.00	0.00	0.
1 01	11.45	47	0.00	0.00	0.00	3.	1 02	0.15	97	0.00	0.00	0.00	0.
1 01	12.00	48	0.00	0.00	0.00	2.	1 02	0.30	98	0.00	0.00	0.00	0.
1 01	12.15	49	0.00	0.00	0.00	2.	1 02	0.45	99	0.00	0.00	0.00	0.
1 01	12.30	50	0.00	0.00	0.00	1.	1 02	1.00	100	0.00	0.00	0.00	0.
									SUM	5.20	4.26	0.94	26248.
										(132.)	(108.)	(24.)	(743.26)

CFS	2363.	1065.	273.	262.	26248.
CMS	67.	30.	8.	7.	743.
INCHES		4.15	4.26	4.26	4.26
MM		105.33	108.12	108.12	108.12
AC-FT		528.	542.	542.	542.
THOUS CU M		652.	669.	669.	669.

ROUTED FLOW THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

STAGE	101.00	102.00	103.00	103.30	104.00	105.00	106.00	107.00	108.00
FLOW	0.00	78.00	236.00	299.00	317.00	1378.00	3211.00	5549.00	8298.00
CAPACITY=	0.	171.							
ELEVATION=	101.	108.							

CREL	SPWID	COGW	EXPW	ELEVL	COGL	CAREA	EXPL
101.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COGD	EXPD	DAMWID
104.0	0.0	0.0	0.

END-OF-PERIOD HYDROGRAPH ORDINATES

MO. DA	HR. MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	0.15	1	0.25	0.	0.	0.	101.0
1.01	0.30	2	0.50	0.	0.	0.	101.0
1.01	0.45	3	0.75	0.	0.	0.	101.0
1.01	1.00	4	1.00	0.	0.	0	101.0
1.01	1.15	5	1.25	0.	0.	0	101.0
1.01	1.30	6	1.50	0.	0.	0.	101.0
1.01	1.45	7	1.75	3.	0.	0	101.0

BY ____ DATE 6/1/81
CHKD. BY ____ DATE ____
SUBJECT ____

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 11/2 OF ____
PROJECT ____

BY ... DATE ...

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. ... OF ...

CHKD. BY ... DATE ...

PROJECT ...

SUBJECT ...

1.01	2.00	8	2.00	13.	1.	0.	101 0
1.01	2.15	9	2.25	37.	2.	1.	101 0
1.01	2.30	10	2.50	83	6	2.	101 1
1.01	2.45	11	2.75	150.	13.	4.	101 2
1.01	3.00	12	3.00	280	26.	8.	101 3
1.01	3.15	13	3.25	509.	50.	16.	101 6
1.01	3.30	14	3.50	845.	102.	28.	102 2
1.01	3.45	15	3.75	1285.	223	47.	102 9
1.01	4.00	16	4.00	1770.	317.	73.	104 0
1.01	4.15	17	4.25	2145.	1324.	96.	104 9
1.01	4.30	18	4.50	2343.	2106.	107	105 4
1.01	4.45	19	4.75	2363.	2322.	110.	105 5
1.01	5.00	20	5.00	2245.	2306.	110.	105 5
1.01	5.15	21	5.25	2037.	2162.	108.	105 4
1.01	5.30	22	5.50	1763.	1933.	105.	105.3
1.01	5.45	23	5.75	1472.	1657.	101.	105.2
1.01	6.00	24	6.00	1238.	1393.	98.	105.0
1.01	6.15	25	6.25	1045.	1233.	94.	104.9
1.01	6.30	26	6.50	887.	1067.	90.	104.7
1.01	6.45	27	6.75	745.	911.	87.	104.6
1.01	7.00	28	7.00	616.	768.	83.	104 4
1.01	7.15	29	7.25	504.	639.	80.	104.3
1.01	7.30	30	7.50	407.	525.	78.	104.2
1.01	7.45	31	7.75	324.	426.	76.	104 1
1.01	8.00	32	8.00	254.	341.	74.	104.0
1.01	8.15	33	8.25	199.	315.	72.	103.9
1.01	8.30	34	8.50	155.	312.	69.	103.8
1.01	8.45	35	8.75	121.	309.	65.	103 7
1.01	9.00	36	9.00	95.	304.	61.	103.5
1.01	9.15	37	9.25	74.	300.	57.	103.3
1.01	9.30	38	9.50	58.	265.	52.	103.1
1.01	9.45	39	9.75	46.	231.	48.	103.0
1.01	10.00	40	10.00	36.	207.	44.	102.8
1.01	10.15	41	10.25	28.	185.	41.	102.7
1.01	10.30	42	10.50	21.	165.	38.	102.6
1.01	10.45	43	10.75	15.	147.	35.	102.4
1.01	11.00	44	11.00	10.	130.	32.	102.3
1.01	11.15	45	11.25	6.	114.	30.	102.2
1.01	11.30	46	11.50	4.	101.	28.	102.1
1.01	11.45	47	11.75	3.	89.	26.	102.1
1.01	12.00	48	12.00	2.	78.	24.	102.0
1.01	12.15	49	12.25	2.	73.	23.	101.9
1.01	12.30	50	12.50	1.	68.	21.	101.9
1.01	12.45	51	12.75	1.	64.	20.	101.8
1.01	13.00	52	13.00	0.	60.	19.	101.8
1.01	13.15	53	13.25	0.	56.	18.	101.7
1.01	13.30	54	13.50	0.	53.	16.	101.7
1.01	13.45	55	13.75	0.	49.	15.	101.6
1.01	14.00	56	14.00	0.	46.	14.	101 6
1.01	14.15	57	14.25	0.	43.	13.	101.6
1.01	14.30	58	14.50	0.	40.	13.	101.5
1.01	14.45	59	14.75	0.	38.	12.	101.5
1.01	15.00	60	15.00	0.	35.	11.	101 5
1.01	15.15	61	15.25	0.	33.	10.	101 4
1.01	15.30	62	15.50	0.	31.	10.	101.4
1.01	15.45	63	15.75	0.	29.	9.	101.4
1.01	16.00	64	16.00	0.	27	8.	101 3
1.01	16.15	65	16.25	0.	25.	8.	101 3
1.01	16.30	66	16.50	0.	24.	7.	101 3
1.01	16.45	67	16.75	0.	22.	7.	101 3
1.01	17.00	68	17.00	0.	21.	7	101 3
1.01	17.15	69	17.25	0.	20.	6.	101 3
1.01	17.30	70	17.50	0	18.	6.	101 2
1.01	17.45	71	17.75	0.	17.	5.	101 2
1.01	18.00	72	18.00	0.	16	5.	101 2
1.01	18.15	73	18.25	0.	15.	5	101 2
1.01	18.30	74	18.50	0.	14.	4	101 2
1.01	18.45	75	18.75	0.	13.	4.	101 2
1.01	19.00	76	19.00	0.	12.	4	101 2
1.01	19.15	77	19.25	0.	11.	4.	101 1
1.01	19.30	78	19.50	0.	11.	3.	101 1
1.01	19.45	79	19.75	0.	10.	3.	101 1
1.01	20.00	80	20.00	0.	9	3.	101 1
1.01	20.15	81	20.25	0.	9.	3.	101 1
1.01	20.30	82	20.50	0.	8.	3.	101 1
1.01	20.45	83	20.75	0.	8	2.	101 1
1.01	21.00	84	21.00	0.	7.	2.	101 1
1.01	21.15	85	21.25	0	7.	2.	101 1
1.01	21.30	86	21.50	0	6	2	101 1

BY J.C. DATE 6/5/?? **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A15 OF A1?
CHKD. BY ______ DATE ________ [illegible] LAKE DAM PROJECT C ??76
SUBJECT [illegible]

1.01	21.45	87	21.75	0.	6	2.	101 1
1.01	22.00	88	22.00	0.	6.	2.	101 1
1.01	22.15	89	22.25	0.	5.	2.	101.1
1.01	22.30	90	22.50	0.	5.	2.	101 1
1.01	22.45	91	22.75	0.	5.	1.	101 1
1.01	23.00	92	23.00	0.	4.	1.	101 1
1.01	23.15	93	23.25	0.	4.	1.	101.1
1.01	23.30	94	23.50	0.	4.	1.	101.0
1.01	23.45	95	23.75	0.	3.	1.	101.0
1.02	0.00	96	24.00	0.	3.	1.	101.0
1.02	0.15	97	24.25	0.	3.	1.	101 0
1.02	0.30	98	24.50	0.	3.	1.	101.0
1.02	0.45	99	24.75	0.	3.	1.	101.0
1.02	1.00	100	25.00	0.	2.	1.	101.0

PEAK OUTFLOW IS 2322. AT TIME 4.75 HOURS

CFS	2322.	978.	273.	262.	26211.
CMS	66.	28.	8.	7.	742.
INCHES		3.80	4.25	4.25	4.25
MM		96.65	107.97	107.97	107.97
AC-FT		485.	542.	542	542.
THOUS CU M		598.	668.	668.	668.

RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES(SQUARE KILOMETERS)

HYDROGRAPH AT	1	2363.	1065.	273.	262.	2.39
		(66.92)	(30.17)	(7.74)	(7.43)	(6.19)
ROUTED TO	2	2322.	978.	273.	262.	2.39
		(65.75)	(27.68)	(7.73)	(7.42)	(6.19)

SUMMARY OF DAM SAFETY ANALYSIS

....	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	101.00	101.00	104.00
STORAGE	0.	0.	73.
OUTFLOW	0.	0.	317.

RATIO	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
	105.52	1.52	110	2322.	4.00	4.75	0.00


FILME
8